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ABSTRACT

Focusing on the need for information systems that provide faculty, staff, and students with open access to all necessary information resources, this paper begins by discussing the issues involved in developing such systems. A review of the traditional environment looks at the traditional centralized resources versus the current trend toward decentralization, the budget processes involved, the demand for immediate results by upper levels of management, and the need for more user involvement in system design. The complementary roles of the strategic planner and the conceptualist in systems development are described, and it is argued that the architecture of an information system which promotes and supports the concept of open access to information is made up of several central criteria: intelligent and intuitive systems, organizational flexibility that supports the ability to capitalize on change, the special challenge of security and access control, and responsible data administration. Each of these criteria is discussed in depth. A realization of this "vision," the User Information System (UIS) at Boston College (Massachusetts), is described in detail, including its "single system image," functional and customized menus, consistency, access control, central directory, intelligent routing, messaging, status tracking, and voice/data integration. It is concluded that the question is not which parts of information technology get distributed and which do not but, rather, how users can be provided with open and easy access to information, and that this "vision" is central to the whole process. A profile of Apple Computer, Inc., the corporate sponsor of this report, and an annotated listing of reports in this series are included. (19 references) (BBM)

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# Open Access:

## A User Information System

*by Bernard W. Gleason*

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# Preface

As we entered the decade of the 80s, most information systems designers were unprepared for the approaching wave of advances in technology. In his 1980 book *The Third Wave*, Alvin Toffler describes interrelated changes in our current society as a powerful tide surging across the world, creating a new environment that is constantly in motion.[1] Similarly, our campuses are experiencing a continuous wave of change. This continuous movement requires the architects of information systems to design those systems in ways that will be adaptable to an unpredictable future.

During the early- and mid-1980s, we witnessed the growth of desktop computing devices in offices, classrooms, laboratories, and dormitory rooms, resulting in the permeation of workstations that provided users with a new sense of individual power. This first wave was followed by a demand for networking and connectivity, and once that is accomplished, the third wave will come as a sharp increase in user demand for access to data and information. The result will be the ultimate collision of the worlds of microcomputer and mainframe computing, and voice and data networks. But the top-down design techniques of traditional mainframe-based systems and the bottom-up approach employed by users empowered with microcomputers can and should coexist in an information system that has the user as the central focal point.

As the rate of change in campus hardware and software products accelerates, we are also experiencing a move toward decentralization of services, or as Toffler calls it, "demassification." This trend puts an increased burden on the information systems manager to provide mechanisms to ensure the integrity of data and to provide a systems architecture that permits users to easily adapt applications to existing data structures and access controls.

The renewal of system design concepts in light of constant and unpredictable changes in business practices and technology requires a new, or sometimes a renewed, look at not only system architecture, but the role of human resources (information technology staff and users) and budgetary considerations. The provision of data access to all members of the college or university community requires the conceptual design of what I refer to as a User Information System (UIS). In the UIS, faculty, staff, and students have open access to all necessary information resources and are able to transact business with the university in the most convenient way.

At the 1988 CAUSE national conference, I presented a paper entitled "Glasnost—an Era of Openness." In that presentation, I outlined the scope of Project Glasnost, a set of system design concepts and techniques that will allow open access to administrative information by all members of the Boston College community. I have expanded those principles in this paper, and I have also attempted to address many of the organizational, managerial, social, and political forces and issues that are consequences of a strategy of open access. While the concepts contained in this paper are being applied at Boston College, the paper is not intended to be an application brief, recognizing that management and technology environments vary from institution to institution. The concepts and principles, however, may have broad applicability. The paper is written so that the concepts can be understood by a broad audience, and it is for that reason that I have purposely avoided identification of specific hardware or software products and minimized the use of technical terminology.

I would like to acknowledge the contribution to this paper of Linda Fleit, President of EDUTECH International, for her editorial work, and Julia Rudy, Director of Publications and Editor at CAUSE, whose training and guidance have helped turn a technologist and dreamer into a writer. I especially want to thank the folks at Boston College—John Springfield, Paul Dupuis, Jack Spang, Dave McCormack, and many others—who have the unique talent of converting ideas into innovative, but practical, solutions.

After many months of trying to find the time to write this paper and still manage a large organization, I elected to employ a system development concept: modularity. I started jogging alone every day at lunch time, reserving my thoughts to this paper, and when I returned to the office, I jotted down my ideas. Special thanks go to Lori Kearsley who daily collected and arranged these ideas and comments into a document. In the process I lost weight—no, this is not another new diet!— but the exercise was really intellectual, and it gave me an opportunity to readdress concepts and to renew a vision of user access to information.

[1]Alvin Toffler, *The Third Wave* (New York: William Morrow, 1980), p. 17.

# 1

# INTRODUCTION

In the past, access to information on college and university campuses has been reserved for a relatively small number of administrators. Even though the benefits of providing users with open access to campus information have been understood by many, the demand has been slow in developing primarily due to organizational structures, including the natural division between academic and administrative computing, as well as management issues, principally serious security considerations. However, reform is now upon us, and it is time to think about a campus-wide user information system that will serve the needs of everyone. Direct access to administrative information by a broad range of the community—faculty, staff, and students—is quickly becoming an expected service. Colleges and universities that have adopted a policy of broad and open access to all administrative information systems, including the transactional systems, with the intention of providing all members of the campus community with open access to information, have already begun to see better service and better quality of campus life, as well as higher levels of office efficiency and information sharing. In many instances, these increases in productivity and service can be attained by adding value in the form of new features to current systems.

To implement a user information system and to facilitate open access, it is necessary to adopt an overall systems architecture and an approach to data administration and management that will provide a platform for universal and secure access to campus information. The concepts inherent in the systems architecture will help lay a foundation that will enable institutions to make a smooth transition to new technologies as they develop and become available. The underlying premise of these concepts recognizes data as primary, technology as secondary, and the building of a knowledge base—the compilation of accurate and comprehensive data and information into a useful and easily accessible structure—as paramount. We will continue to see changes in hardware and software tools, but the data requirements for completeness and consistency across all systems will remain constant. The swift advances in technology are reducing the life of hardware, and in many cases software applications are becoming obsolete because they were designed to run on obsolete platforms. The one constant is data; data are never obsolete. For example, the primary data elements found in student record files are substantially the same in type and acceptable values as they were ten or fifteen years ago.

Over a decade ago, systems designers at Boston College planned the transition of systems from a batch processing mode to an online interactive system. At that time, integrated online systems were clearly the direction of the immediate future, just as the direction today is toward integrated systems with data distributed over a network, some data resident on a machine acting as a server, and some processing and data located on an intelligent desktop device acting as a client. But regardless of the direction, whether a decade ago or now, it is important to design the new model on a defined set of concepts and principles, not just on a technology. The buzzword of a decade ago, integration, has progressed to a new set of requirements for interoperability, but the principles and concepts, although needing updating, have not really changed.

It is not the task of the information systems planner to predict the future, but to establish a framework that will facilitate transition. Who could have accurately predicted in 1980 the impact of personal computing? Who is willing to predict what our institutional and computing and communications environments will be like in the year 2000? What we do know is that the empowered user will want to use the most convenient resource to access information.

In the mid-1980s, three significant technologies influenced the architecture of administrative systems at Boston College. The first was the Apple Macintosh, introduced in 1984, with its easy-to-use graphical interface, its desktop metaphor, and the consistency of the interface across all applications. The second was the use of voice response for conducting student course registrations, first used by Brigham Young University. And the third one struck me at the 1984 CAUSE national conference, as I used my bank card at an automated teller machine on a street corner in San Francisco to withdraw cash from my account back in Boston. I thought to myself, "If I can access my account all the way across the country, why can't we provide access for our students to information on campus?" While our basic principles remained the same, the influence of these events led us to develop an extension of

our systems architecture to facilitate direct user interaction with systems and to adopt emerging technologies.

Information technology managers need to take a leadership role in helping their institutions stay flexible and adaptable, defining and developing an overall structure consisting of a set of fundamental concepts for the collection, administration, and distribution of data that will establish a framework within which institutions can effectively exploit information technology as it evolves and changes. Colleges and universities are, in a sense, businesses which compete against each other for talented students and monetary resources, and like corporations, colleges and universities develop information systems that support the business enterprise. Increasingly, these information systems are being utilized to gain a strategic or competitive advantage over other colleges and universities. (Unlike the corporate world, colleges and universities freely exchange strategies and information with each other—a practice that could be argued doesn't make sense—but the university marketplace is so fragmented that the competitiveness, while real, is not readily apparent, i.e., it is not Coke vs. Pepsi.) While information systems must complement and support the institution's mission and overall strategy, there are many potential opportunities to exploit systems to gain a competitive edge. That edge most likely will be the cumulative results derived from a collection of innovative and integrated systems that effectively serve our users.

The issue for the information systems manager is not where to go, but how to get there. How can the institution's systems be further exploited? How do systems make the transition to a new technological platform while protecting the institution's investment? How do integrated systems continue to adapt to a new distributed environment without discarding the precious attribute of integration? The forces of change are irresistible, and the future is uncertain, but the immediate opportunity is to permit all members of the institution to become participants in the information age by providing open access to information.

# II
# The Traditional Environment

Administrative managers and systems designers are often viewed as a group of inflexible bureaucrats who are tied to obsolete technologies and are more interested in retaining control than in sharing information. In reality, the fondest dream of every enlightened information systems manager is to apply positive change to the way the institution functions. For many managers, this has meant almost constant redefinition of the campus information model, limited only by the design of the underlying infrastructure, but always with a commitment to serving users. As Saint Ignatius Loyola advised us 450 years ago, knowledge should be used in the service of people.

Terms such as "stable," "reliable," "secure," "closed," "procedural," and "integrated" are often attributed to mainframe-based administrative systems. Depending on one's point of view, some or all of these adjectives may be interpreted positively. But the ultimate measurement of an administrative system is not whether data are distributed or centrally stored, or whether the user interface is intuitive, or whether the applications are creative; rather, it is whether the system is reliable. It is certainly the aim of the system designer to interject innovation, but the application of new ideas must make use of proven technology and techniques. The individually-empowered microcomputer user can fail, but the computing and communications services that support the administration of the institution must be error-free and well managed. Empowered users have experienced the personal productivity rewards of being able to function independently, but one of the challenges is to extend the power enjoyed by personal computer users to the traditional mainframe-based administrative computing environment. These empowered users have also suffered the frustration of having limited access to data located on systems outside of their personal or departmental domain, and the challenge to information systems management is to build an appropriate systems structure and plan the transfer of organizational and personnel responsibilities to address the demand.

Four major issues inherent in the traditional information systems environment have played a key role in affecting the progress many institutions have been able to make by taking advantage of technology: the argument concerning centralization or decentralization of information resources, budget processes, the pervasiveness of a short-term focus, and the role of the user.

## Centralized vs. Decentralized Resources

One of the major difficulties in the centralize/decentralize argument is the lack of clarity between *control* and *management*. Control of data and information should always be in the hands of the users, but the responsibility for management, including the management of technology change, should be in the hands of the information systems professionals.

The physical decentralization of hardware, data, and other resources is one aspect of the issue. However, what troubles many of the people involved in the management of information technology is the low level of influence in the institution's computing decisions by the institution's primary (and central) technology services department. It is as if campus users believe they will get better service when they have control of the programming staff, the computer equipment, and the software. Unfortunately, what often results is a short-term benefit that eventually hurts the users, as well as the rest of the institution, in the long run.

Why would any institution want to create these problems? Obviously, the intent is not to create problems, but a short-term focus inadvertently does just that. For institutions that have taken the approach of allowing everyone to define everything they want on individual processors, an enormous infrastructure of bridges, gateways, translators, and converters will eventually and inevitably be needed. These institutions seem not to want to have someone orchestrating how it should all happen; but it is not unlike having the controller's office allowing everyone to develop his or her own chart of accounts and accounting system. If, for example, a grant-accounting system is developed by one user department in isolation, any number of layers of extra work will be added throughout the institution in order to provide access to that information for everyone who needs it. This department-based system may solve an immediate problem, but, in fact, it will inevitably cause the institution's bureaucracy to grow if it is not developed in the context of an overall systems architecture.

Another major issue in the force to decentralize is the assignment of computing personnel to specific user departments. It seems so logical, since it appears to guarantee the continuity and quality of ongoing work for the user, such as putting in new software releases. However, an important way for computer professionals to develop a global systems perspective is to have involvement in all sorts of different activities and systems, and not be pigeonholed. In addition, it almost always becomes the problem of the central information technology organization if one of those specifically-assigned people leaves the institution. The user has to turn somewhere for support, and the somewhere is usually central services. The biggest difficulty, however, is having enough resources to work on major projects that cross organizational boundaries. If all of the computer personnel are allocated to specific departments, then major institutional projects may never get implemented. Institutions that have reallocated personnel to specific user departments under the guise of decentralization may have seriously disrupted the course of progress toward the campus-wide system.

While the perils of decentralization are debated, it is important to accept the fact that the movement of functions from a central computing organization out into user departments is an irresistible force. The advocate for this change should be the central computing and communications management, and like any other activity, planning for the transition is the key. The computing and communications organization should retain appropriate management responsibilities for services that should be managed centrally. Although the users in departments are customers and, as such, they have the right to expect a certain level of support and the capability to perform many tasks locally and without direct assistance, in many instances, central management is understandably concerned about control. After all, many information systems managers have labored for years to fulfill the dream of an integrated and managed set of information systems, and are fearful that the structure will fall apart if control is lost. This fear may, in fact, be justified if a framework or architecture for change does not exist.

While the term "centralized" may be viewed in campus political circles with great disfavor, centralized *planning* is a key factor in the design of a campus-wide system that will support the concepts of openness. Centralized *management* of the primary knowledge database is necessary to provide the high degree of referential integrity which ensures the validity of shared data. This strong statement of data management applies whether or not the environment is distributed, and the distinction between planning, management, and control is very important. Control belongs to the users, planning is a joint effort, and management of the environment is a responsibility of the information systems staff.

The goal of information system designers a decade ago was to build a completely integrated online system. For many, there has been a transition from batch to online processing, but the promise of an integrated environment has never materialized. In most cases, this online system was mainframe-based because a timesharing system was the only practical solution for data sharing. If it was difficult to develop an integrated system in a mainframe environment where all data were stored and managed centrally, the present-day system designers worry that the task will be impossible in an environment with data distributed over a network and users empowered to develop their own applications. In this evolving distributed environment, there is a greater and renewed need to manage the integration process. As more and more systems are developed, there is a greater potential for chaos. While it is important to design administrative systems in a completely integrated manner, it is equally important to view administrative systems as an integral part of the total campus information environment.

## Budget Processes

Typically, budget projections in colleges and universities are laid out during the fall for the next fiscal year, which normally begins the following July. The problem is that budget defenses may rely on known products, and those product selections are often thrashed out by committees which may have started their work well before the budget projections. By the time the funds actually get spent, many of the product choices may be a year old or more, and in some cases may actually be outdated. That certainly does not fit well with the idea of formulating an overall strategy and then taking advantage of new technologies as they appear.

Technology is clearly moving much faster than typical institutional processes. Because of that, information technology managers have to coordinate the budget process, especially with regard to translating strategic and tactical plans into shorter-term operational plans. They must also develop different ways of approaching the budget process, such as using a multi-year rolling capital budget which does not make mention of specific products. This requires the institution's management to look at expenditures quite differently from the way they may be accustomed to, but it is important to have the flexibility to implement new ideas and approaches when the time is right.

The setting of priorities for systems development and resource allocations is partly dependent upon financial considerations, but available budget funds should not be the only, or primary, determinant. In institutions where budget is the principal mechanism for setting priorities, one is likely to find the highest level of systems chaos and the lowest degree of institutional focus. For institutions in that category, many of the strategies outlined in this paper are not realistic. Systems priorities should be governed by a strategic plan that is consistent with the overall academic and administrative plan of the institution. If open access to administrative

information is one of the cornerstones of the strategic plan, then there is an implied assignment of a high priority and an allocation of resources to applications that will benefit a broad base of the user community.

The price/performance of computing and communications equipment is improving at startling rates, but on most campuses the aggregate capital and operating spending for hardware and software across all departments is one of the fastest-growing budget items. At an increasing rate, user departments are using discretionary funds to purchase both new equipment and upgrades to old systems in order to stay technologically current. Trustees and other budget planners, while tracking tuition costs that are spiralling annually at a faster rate than inflation, and faced with the task of reducing costs, are likely to target computing budgets across all units. Management will likely question the return on investment in systems, particularly if they are not satisfied with the ability to receive timely information to support decision-making. Providing access to administrative information to a broad base of the community to support decision-making increases visibility, and is one means of providing demonstrable uses of technology to justify the spending levels. Providing the best systems facilities to the management of the institution would seem to be a wise strategy.

## Short-term Focus

A very serious problem is the need to satisfy the demand for immediate results. How does one monitor compliance to an overall systems architecture in light of the availability of new hardware and software tools for users? Is the effort worth it? Even for the applications development staff, especially the ones who work directly with users, the temptation to use short cuts is great. A major effort to conform with an overall design or architecture may not have an immediate impact on the users—it may even look like unnecessary overhead—but it must be seen as an investment in the future. The desire to respond to a demanding user is understandable, but inevitably that same user will reappear with an operational application, and instead of being able to fit it directly into the architecture, a great deal of backtracking and retrofitting may be required. A strong argument can be made that it is more efficient to take the time initially to do it right, and to include the elements and features that will be needed at a later time, even if it means the initial project will take longer.

For professionals who have spent a career developing large database application systems, it is a fact of life that administrative information systems are extremely complex. To the uninitiated, particularly in the academic area and upper levels of management, this level of complexity will probably never be fully appreciated and, consequently, it is important to present to this constituent group a very straightforward view of available and potential systems capabilities without compromising long-term objectives.

## User Involvement

While some users may have early access to new software packages and be able to generate many new ideas, it is still the duty of the information technologist to keep abreast of new innovations, to research applicability, and to promote solutions. It may not always be advisable to get the user involved early; in administrative systems, it is equally important to deliver proven technology. Accustomed to working with proven products, most users have a tendency to view all products as being in some stage of the move into production. Technologists are accustomed to experimenting, evaluating, and possibly discarding a product. The important thing is to get users to be thinking about new ways of doing things, and to exchange ideas with the information technology staff.

As users gain technological expertise, they gain individual power, but their primary expertise remains in their individual disciplines or business activities. It is not uncommon for a user to become expert in a particular software package, and then to advocate the virtues of the product, but that is not a reason for computing professionals to abdicate the role of technical expert. This is a role users want technologists to fill.

In the past, systems analysts were trained to become knowledgeable about the inner workings of administrative departments, and to create top-down system designs, including changes in office operating policies and procedures. At the same time, we had user support people providing assistance to academic users without necessarily having an in-depth knowledge of the discipline. We are now seeing a shift in paradigm in administrative systems, with the user department performing the analysis, and the information technology unit still providing the technical support. And in many user departments, we are witnessing the evolution of department liaison staff. In addition to the increased availability of technology, these departmental groups are growing because the dual-focus personnel are "business attentive." Over time, many application development programmers have become less knowledgeable in the operation of user offices while users have become more knowledgeable in system capabilities; this has led to users solving business problems without the assistance of professional programming support.

For information systems to make a difference, there is a need for a high level of commitment from both the user department and information system management, not just in staff resource assignment but in management's time. Too often, the delegation of responsibility for overall system requirements to individuals at lower levels within both information technology and the user office has led to a relationship yielding functional solutions but little in the way of information to support executive management or information sharing among departments.

# III
# THE VISION

Most of us have come to accept the idea that determining the ways in which computing and communications services will be delivered to the campus must start with the development and distribution of a strategic plan. Furthermore, the plan should be developed and refined through participation of the campus community, and it must be consistent with the overall strategy of the institution. Strategic planning must be geared to a strategic vision, and the practitioners must take ownership and share the vision over the long-term. That strategic vision is not limited to technology, but must also include a clear set of concepts and principles that will guide the development and management of data systems and resources. As John Naisbitt states, "Strategic planning is worthless—unless there is first a strategic vision."[2]

The conceptualist's view of systems, however, should be distinguished from that of the strategist. The strategist may develop a plan covering many years, including a statement of goals, objectives, and the means to achieve the objectives. The conceptualist, on the other hand, will develop concepts which describe a general set of principles but which are not time-dependent; the rate of implementation will be governed by the availability of the technological tools and general compliance with strategic plans. This set of concepts is also constantly being manipulated and adjusted to fit technology as it changes. As we design a systems architecture, we will always be aware that we are not building an inflexible structure but rather a framework within which we can adapt to change. As Toffler tells us, "We must accept the accelerating rate of change and how the rate of change will disrupt the inner equilibrium, but our task is not to predict the future, but to be imaginative and insightful without worrying about being one hundred percent right."[3]

The conceptualist's view of the world is a long-range view. The framework which is developed from the basic concepts may take a very long time to put in place, but it serves as a constant guide for making shorter-term decisions. One thing is clear: there are no quick fixes, and short-term gains may often sacrifice long-term benefits. The visionary seed planted by the conceptualist may take many years to yield a practical application product, and the systems development group, as well as the user community, may not be enthusiastic about doing all the required groundwork if the effort seems not to have apparent near-term impact. However, systems planners need to base judgements on a belief in long-term solutions.

An information systems architecture which promotes and supports the concept of open access to information is made up of several central criteria: *intelligent and intuitive systems, organizational flexibility* that supports the ability to capitalize on change, the special challenge of *security and access control,* and *responsible data administration.* The glue which holds all of the ideas together is the *credibility* acquired by the system designers over time, through the successful implementation of applications.

## Intelligent and Intuitive Systems

In part, the intelligence of a system comes from the permanency of the underlying structure of the institution. In its simplest form, an educational institution is composed of a set of buildings, where courses are taught, research is conducted and students live, and a collection of positions that are filled by individuals who teach, research, answer telephones, operate computers, and so on. The brick and mortar of the buildings, the faculty and employee positions, and the organizational structure are the aspects of the environment which are permanent. These are the things people move into and out of. They have relationships to each other. They have attributes that will be used in every component of the system. When someone joins the campus community as a student or employee, he or she becomes identified in the system as an entity and assumes certain characteristics which are associated with the permanent aspects of the system. For example, when things happen in the institution, the intelligent system is smart enough to know which individuals, occupying specific positions, should be informed of which activities, and then sees to it that these individuals are informed, through electronic mail or some other media.

[2]John Naisbitt, *Megatrends* (New York: Warner Books, 1982), p. 94.

[3]Alvin Toffler, *Future Shock* (New York: Random House, 1970), p. 32.

Intelligent systems will affect productivity enormously, just by cutting down on the amount of time everyone spends on the telephone trying to obtain and dispense information. No more having to call the accounts payable department to find out if a vendor has been paid—the system will inform everyone who needs to know when an appropriate action has occurred. No more calling the registrar's office to find out if a grade change has been made; the system will not only let the faculty member know when it has been done, but it will inform the student as well. The system will keep track of all important activities and give status reports at appropriate times to the appropriate people.

Having an intelligent system is a very different approach from the traditional systems view; most systems, especially the ones designed for executives, are simply management reporting or exception reporting systems. We spend a tremendous amount of time teaching people how to use tools in these systems, such as query languages, to build *ad hoc* information requests. In fact, the intelligent system should know what each person on the system needs to know, and when he or she needs to know it, and then when those points are reached, the system should take care of dispensing the information. In partnership with an intelligent system, the individual user should not need to initiate anything; he or she only needs to be the recipient. In the near future, expert systems linked with easy-to-use graphical interfaces will provide users with an intelligent core that will provide help services similar to those supplied by a reference librarian. It is also easy to envision the day when a user will have access to full text retrieval capabilities, and many other kinds of information will also become available to every campus user.

A major player in this new environment is the library. One of the many roles of the library is to provide access to information, and it is appropriate to conceive of access to administrative systems information being managed within the same structure as access to library materials. After all, library clients—faculty, students, and staff—are the same customers being served by a policy of open access to administrative information. The library model includes not only access to information, but free access as well. By providing free and open-access libraries, we encourage the use of available facilities, rather than inhibiting usage by charging fees. The major difference is that most library materials are not confidential, while access to administrative information obviously needs to have security controls.

In some systems which are intended to be used by everyone, some individuals will not understand the use of computing devices, or will be averse to using the capabilities. System interfaces must be designed to accommodate users in this category, not shut them out. In the design of user interfaces, we have to keep reminding ourselves that the system is going to be accessed by everyone, and that the interface should not require any special instructions or documentation. We also have to expect the fact that some users will perform only a small number of functions, while others will demand access to a broad range of information resources. The users with the most extensive requirements are likely to be the most sophisticated and demanding, but, as a strategy, it is critical to first address the majority of people with a limited set of capabilities, rather than serving a select few.

Minimizing or eliminating the interface issues is a key design consideration for providing self-service devices. There are other technologies which in the future will address the requirements of non-technical users: handwriting and voice recognition and natural language processing. These technologies are either not yet completely developed or not reasonably priced, but we can use intuitive techniques as a substitute for these natural interfaces. For instance, instead of systems being able to recognize voice prompts, we are witnessing a wide usage of telephone voice response techniques in which a user replies to voice prompts using a touch-tone telephone. In addition, for retrieving information, it is natural for users to want to issue a statement such as, "Give me all the accounts in the College of Arts that are over budget," rather than constructing a structured query which requires training in the use of query language. In the interim, we are seeing the development of graphical interfaces allowing users to simply point and click at buttons on a screen without being required to view or understand the syntax of the query. The ease of interaction with systems will be further enhanced in the future by the inclusion of other types of media into the graphical interface—i.e., audio (music and voice) and video (color and animation) technologies.

Many computing and communications interfaces have gained the label of "intuitive" not only because of their so-called "ease of use" but also because of the acceptance that commonly-used interfaces have acquired through broad exposure. For example, the telephone has been an accepted medium for a long time, but we have all now embraced a variety of other devices as well, such as telephone voice response units and automated teller machines (ATMs), that were not even a consideration for broad public use a decade ago. In recent years, the quick acceptance of graphical interfaces by the user community has been recognized and promoted in the computing industry as the future of man-machine interaction. Graphical interfaces will present a consistent and easy-to-use approach to the system from the user's point of view. These interfaces will not only reduce the need for user training and support, they will also allow us to build very easy-to-use, intuitive systems. In the next few years, we expect to see interfaces with expert systems capabilities that will allow even the most unskilled individuals to easily interact with systems.

In administrative systems, graphics have long been a desired means of displaying report information and, as mentioned,

the graphical front-end is emerging as the common user interface. An extension of the graphical interface is the storage and management of the knowledge base in graphical form. For instance, when we think of a building, we visualize a floor plan, not room numbers, square footage, or coordinates in columns and rows. The common user image of organizational charts is a hierarchical structure in graphic form, not departmental account numbers, job titles, and names linked together in a database. Individual students are recognized by name or facial image, not by a social security number. A geographic region is pictured as a map, not as a collection of zip codes. The campus network is commonly represented as a topographical view of cables and conduits layered on the campus and building blueprints. In the past, systems designers have chosen to shortcut or avoid the automation of these graphical databases for a variety of reasons, most notably the memory and storage requirements and the limitations and/or costs of workstations. But this is changing quickly.

When we installed ATMs on the Boston College campus for student access to information, one of the major considerations was the familiarity of the device; we wanted to help off-load high-volume transactions, provide routine service, and minimize training requirements. The acid test was to see if students would use the device without any instructions being posted, and it worked. Interestingly, it works so well that students queue at the ATMs outside the registrar's office, much like many of us do at the bank, even though they can enter the office during normal business hours and be served at the counter.

The effective delivery of services is a critical concern in differentiating the quality of one institution from others competing for the same students. An intelligent and intuitive system can add immeasurably to that quality.

## Organizational Flexibility and the Ability to Capitalize on Change

Day-to-day activities come from tactical plans which are derived from strategic plans. But this all happens in an atmosphere of constant change. In order to be able to capitalize on changes and not be overwhelmed by them and thereby possibly lose valuable opportunities, the organization has to be flexible. One of the measures of this flexibility is in the allocation of staff resources. The hierarchy needs to give way to a more horizontal structure, with fewer titles and greater ranges of responsibilities within position definitions. The information-based organization, as described by Peter Drucker, is one that has a flattened management structure and uses information technology to provide critical information to all members of the organization.[4] If one believes in the information-based organization, then it is reasonable for an information technology manager to apply these principles to the internal organization, and to foster the provision of required information resources that will allow other departments to similarly adapt their organizations.

Dr. Frank B. Campanella made the following remarks in the 1986 version of the *Boston College Strategic Plan for Computing and Communications*:

> For colleges and universities the developments in communication and computing technologies, which have created the "Information Age," are of critical importance. Our strategic business is *information*. We create it, store it, retrieve it, and share it in all its many forms from knowledge on the high end, to information at the mid-point, to raw unprocessed data ready for study and research, at a lower level. Information is our only business, more so than it is that of an IBM or DEC or Apple, as hardware manufacturers, or Lotus and Cullinet as software developers. These are companies which, however effective, provide only the means to access and process data and information."[5]

Our campuses are experiencing trends, such as the proliferation of networks, the rapid permeation of workstations, the integration of voice and data communications, and the emergence of the library as an information utility, that are accelerating the convergence of the academic and administrative sectors. At many institutions, this changing of relationships has led to a restructuring of the campus computing and communications organizations. Becoming information-based is likely to evolve by exploiting existing information resources to make institutional information available at all levels of decision-making. In order to convert traditional hierarchical structures, information must be accessible at all levels.

In the information-based system, Drucker envisions two separate units within the same organizational structure: a managerial unit, or doers responsible for optimizing the current systems, and an entrepreneurial group making current systems obsolete and working on tomorrow.[6] The institution needs to recognize a new class of workers: those who have broad knowledge of computing and communications capabilities, and who have the ability to apply this talent. We might refer to them as "integrators": they are the ones who know how to cross organizational and technical boundaries to get a task accomplished. Also in this class are the "adaptors," the ones who know how to apply new

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[4]Peter F. Drucker, *The Frontiers of Management* (New York: Truman Talley, 1986), pp. 203-204.

[5]Frank B. Campanella, *Boston College Strategic Plan for Computing and Communications* (Boston College, 1986), p. 1.

[6]Drucker, pp. 205-206.

technologies and ideas to the existing architecture. With the growth in technology in recent years, every campus probably has personnel with these capabilities, but who are not necessarily recognized as such, or employed properly. The information-based organization places greater responsibility on the individual and on information technology to provide effective mechanisms for communications so that individuals understand goals, priorities, and relationships. The assignment of greater responsibility to the individual does not negate the need for accountability, and performance needs to be measured against a work plan that can be thought of as a tactical job description.

One of the reasons that information systems managers struggle with staffing problems during this time of rapid change is that they did not address the issue at the time the employee was hired. During the interview process, managers will usually look for the appropriate combination of education, experience, intelligence, and so on. But when faced with a decision which represents a trade-off between specific experience and potential, managers often opt for the short-term returns of experience. The problem with this is that the acquisition of another employee with special skills might ease the pressure on current demands, but might inhibit flexibility in the longer run. In an information-based culture, the individual will be empowered with information that will permit him or her to attain a higher level of achievement. In a high-wage information economy, people are paid for their unique intelligence, not for their collective brawn. As George Gilder states, "Wealth comes not to the rulers of slave labor but to the liberators of human creativity."[7]

Another reason to remain as flexible as possible is that a primary responsibility for any information technology organization is to try to put itself out of business. Of course, this will never literally happen, but it should be an objective within which decisions can be made to automate as much as possible, and to put emphasis on users becoming independent. We have seen over the years the dispersion of services such as data entry and centralized word processing. We are now witnessing the move toward "lights-out" machine rooms and the elimination of operators. We are experiencing demand for services in the microcomputer support and training areas, but the solution is not to build a big training center. Rather, the demand will be met by the development of self-training guides, online animated help facilities, and local experts in user departments. Information technology departments, like all areas of the administration, are simply overhead to the real purpose of the institution; they have no inherent value in themselves and should, therefore, be reduced wherever possible.

The future of programming positions, as we have known them, is limited. Over time, we have seen some trends that are increasingly detrimental to the long-term career objectives of application programmers. For instance, many programming teams are organized around application systems, such as payroll. This type of structure is commonplace, and usually thought to be desirable from a user standpoint. However, the programmers in this type of environment quickly lose a perspective of the overall systems environment, and may begin to take their direction from the user department; technological advancement may give way to expediency.

Within any information technology organization, one sees groups that are assigned to strictly production tasks, such as programming, and other groups providing only user support functions. Just as the programming group must move more toward a support role, the traditional user support groups must take on higher levels of technical expertise and development. The converging of these groups should result in an information technology organization with a mission of providing facilities management (i.e., operations, networks, security, etc.) and user support on a very high level.

The cost of retraining personnel is high, and not always easy to sell in terms of budget and the time requirements away from daily tasks. Perhaps the biggest obstacle is an inability or unwillingness of employees to be constantly acquiring new skills and altering job responsibilities, but retooling the skills of systems staffs is an issue that must be faced by managers in a time of rapid change. As technology changes, new types of skills and specialties will be required.

Another sign of changing times is the number of job descriptions being modified in user departments to reflect changes in job responsibilities as a result of the influences of technology. In many instances, productivity tools have made jobs easier, and as a result, the worker can accomplish more, or add new responsibilities. The evolution of a new class of end user provides a perplexing problem to human resources departments and management; technology has increased productivity and reduced trivial tasks, but has spawned a new class of worker in the user office requiring a new set of skills and probably higher compensation.

In addition, the complex nature of projects spanning many units in the organization has made matrix management a particularly challenging technique for providing organizational flexibility. Almost everything an information technology department does involves varying components of the organization; a single project may involve networking, software support, hardware selection, user training, and so on. Matrix management requires the formation of dedicated project teams without regard to an individual's "official" place in the organization. But one of the most frustrating aspects of matrix management can result from project teams made up of

[7]George Gilder, *Microcosm* (New York: Simon and Schuster, 1989), p. 18.

members from different parts of the organization who may or may not agree with the team leader's decisions, often leading to a great deal of controversy and an escalation of decision-making.

Finally, in order to maximize organizational flexibility without creating chaos, the institution must have someone who can keep all of the sections of the orchestra in rhythm. Some universities refer to this position as "chief information officer (CIO)," but that is actually a misnomer. The term "CIO" implies that there is someone who is in charge of all information; it reverberates back to the old idea that the computer people own the data. Nothing could be more wrong. What every institution does need, however, is an information planner—not a collector of information, but an architect of information structure. The top information systems manager should be responsible for the management of the computing and communications facilities and the design of the systems, but should have no authority to create, modify, or distribute information. It is in this position that leadership becomes so important: the person filling the position is not only the chief architect of the vision, but must foster compliance with the vision as well—not so much through position power as through personal influence. The information systems architect must exert the leadership necessary to keep everyone, staff as well as users, consistently heading in the same direction.

## The Special Challenge of Security and Access Control

When espousing the virtues of open access to administrative systems, I often encounter a reluctance to push the boundaries, particularly out to students. The limits of student access are commonly set at providing access to bulletin boards and other public access information. In most instances, one hears defensive responses such as, "Our students are clever, and will find a way to beat or infiltrate the system." Obviously, security is a major concern, but banks are dispensing money through ATMs, and they certainly would not do so if the environment was not secure, or if they had adopted a "can't do" attitude. It requires a positive commitment to envision what is possible, and to drive toward that goal of open access.

The critics of a strategy of open access to administrative systems routinely express their lack of confidence in the user community to adhere to security and access control policies and procedures. It is often stated that the problem is not the security system, but the people. The concern is genuine, but a policy of limited access will only make the problem worse. If people are not protecting anything of value, then they will not feel a need to follow security procedures. For instance, when a person loses his or her wallet, the first response is usually, "I don't care too much about the money; I'm worried about the credit cards." This is because the credit cards have greater value. Similarly, if the campus ID card is used for accessing a multitude of services, including debit card functions and information access, then ID cards and associated numbers and passwords will also be valued; they will be protected in the same way that individuals protect their bank cards and associated passwords.

In almost any discussion of access to information there is also a debate regarding the granting of authority to retrieve data. In most instances, operational information flows across the institution from department to department in a horizontal manner and is not restricted by organizational boundaries. On the other hand, authority to access management information tends to be vertical, and the routing of the information and the permission to access the information passes up through the hierarchical organization structure. The information systems manager is often placed in the position of seemingly not providing the desired information and of not having the authority to take corrective action.

In the information-based society control of information can be power but, contrary to what is often thought, offices that have custodial responsibility for data are not usually reluctant to release information to proper recipients. There is, however, a genuine concern for misinterpretation or accidental misuse. This concern often leads to the custodial department releasing a limited amount of information on a periodic basis and establishing a procedure to review all requests for additional information.

A major administrative question is how to maintain the individual access control profiles of thousands of individuals at an institution across various computing environments, without expanding the security administration function. In fact, access control can be handled in a very straightforward and efficient manner by assigning access privileges to all of the positions (job slots) in the institution. In a sense, access rules are really nothing more than translations of job descriptions. While systems are usually built around the idea of individual access, it is really the entity that the individual fits into which should provide the characteristics for access privileges. This is a desirable way to eliminate the potential administrative nightmare in managing access control for large numbers of individuals.

For example, let's say that Employee A who works in the registrar's office needs access to information from the accounting department. Often, there will be some sort of access-granting procedure in place requiring the registrar to petition a security administrator on behalf of Employee A. But then when Employee A leaves and Employee B comes in, the access-granting procedure must be invoked once again. And if Employee B is from another department, his or her old access privileges should be revoked, but chances are that no one will remember to do that. Eventually the access control system, in addition to becoming a bureaucratic tangle, gets so broad as to be hopelessly insecure. The answer is to have

a human resource system that is linked directly to a position-based access control system in which job descriptions are translated into need-to-know and need-to-update definitions. New people entering existing positions will require no action at all. Multiple positions held by single individuals can be mapped together easily. Basing security on positions rather than on people relieves the paperwork burden and results in a more secure system.

The other characteristic of access control is the number of levels needed for particular activities. There are four parts to access control: authentication, identification, encryption, and location. For example, in the use of an ATM, a bank card inserted into the slot identifies the individual using the machine, a supplied password authenticates the individual, the data is transmitted in encrypted form, and the system's ability to sense the origin of the transaction (ATMs are usually bolted into place) pinpoints where the transaction is located. All the components are necessary since ATMs allow people to access money; security has to be multi-level and rigorous. But security is a function of risk, and other activities require different levels. For instance, it is not necessary to know the location of someone accessing his or her electronic mail messages and, in some cases, even the use of a password is not necessary. Library catalog information may be accessed by anyone, even someone not identified as holding an institutional position. The nature of the information should dictate the necessary levels of access control.

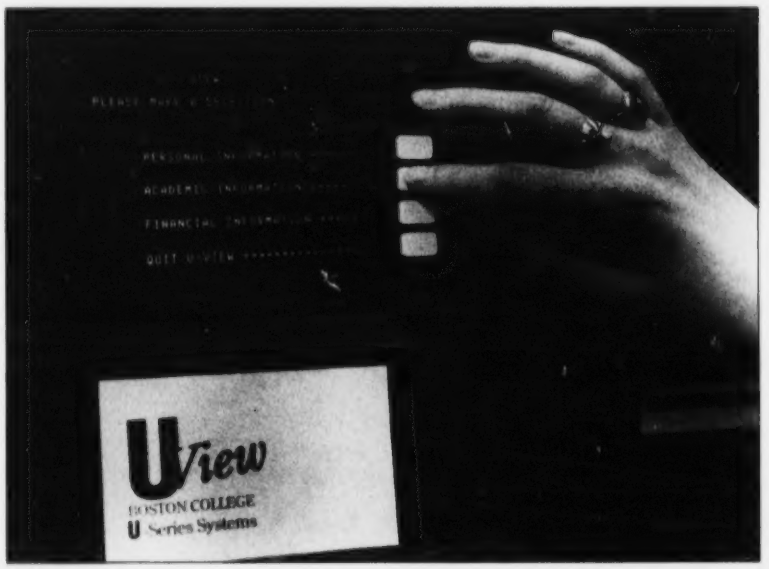
## Responsible Data Administration

Managing "corporate," or institutional, data can be a perplexing problem. Institutional data are needed throughout various offices for different reasons, and certain data elements may or may not be the responsibility of particular offices to maintain. For example, it may seem logical to have the buildings and grounds department be responsible for maintaining blueprints of buildings and a corresponding database with room numbers, capacities, locations, and so on, but the problem may be that they do not have a genuine interest in the maintenance of this information. Changes to prints or to the file may be so infrequent that department staff may make manual notations, or cannot remember how to make file modifications, and may put them off until a problem arises. No one in the office is conditioned to make changes; no one is particularly sensitive to making the changes on a timely basis, even though theoretically, once the change is made, it will promulgate throughout the entire system. If people in other offices perceive this data to be unreliable, they will duplicate it by maintaining their own data locally.

In many institutions, the person responsible for administration of institutional data is also the person responsible for institutional research. It is certainly in that individual's interest to maintain the accuracy and integrity of institutional information, especially in managing summaries over time and in creating decision support systems. Another alternative is to manage institutional data through the information technology department itself. Unfortunately, this seems to be a function that can be handled only through some sort of centrally-located position.

Since the introduction of the personal computer, we have experienced personal productivity increases through the use of word processing and spreadsheet software. Although the availability of database software for microcomputers has been just as extensive, with the exception of small data systems the implementations have not been as successful as with word processing and spreadsheets. The principal reason for this has been the need for local database applications to interact with data located on other systems. The first two available facilities, terminal emulation and downloading of data, now will be supplanted or complemented by client/

***A Boston College student accesses student information using a device similar to an automated teller machine.***



server architectures that will directly address the issue and usher in a new era of database management. The use of a relational database management system on a server allows functions that are best done on a host system, such as control of data files and coordinating of those files, to be done centrally. The continuance of strong management in the changing world of distributed computing will require an adaptation of the basic systems architecture and the fostering in user departments of the idea of a client/server environment. Individual users need to be working not in a disjointed mode, but developing cooperative processing applications. The whole idea is to be able to ensure data integrity and referential integrity across systems by putting as much value as possible into each of the data elements. Then as the data are shared across systems, there is a requirement for the process to be synchronized.

In order for the client/server environment to catch on and to move the system design away from a terminal-based architecture, there needs to be an inducement in the form of some application that is significantly better. The most logical choice is the use of graphical interface facilities on the personal computer as either a front-end to a host application or as a local-processing node. In both cases the presentation of business forms on screen will permit users to interact with the system over a network as though they were using standard paper forms, and will ease the transition by establishing a sense of familiarity.

## Credibility

Leadership depends on credibility, and credibility comes about over a long period of time through delivering promised results. Credibility is the *sine qua non* for the information systems conceptualist trying to promote a long-term vision. There are times when it is simply a matter of trust for the institution to go along with the conceptualist's ideas and recommendations.

The critical ingredient is to make it all believable, both to institutional management and to the users. One way to do this is through prototyping, a way to avoid subjecting users to months' worth of design, and years' worth of programming and testing, and then finally delivering a product several years later. Prototyping gives the users something concrete to look at, and to contribute to early on in the development cycle; it also gives users some immediate feedback for their ideas and comments. It is a way to get from the abstract to the real. While prototyping is just one technique, the real issue is that users need to see something happening all the time. Constant refinements and advancements, even if slight, promote a sense of continuous progress.

But in an environment where there is an overall systems architecture that is part of the "big picture," it may not be practical to expect the user community to comprehend all the dimensions. The development of a comprehensive set of system designs and a set of prototypes may not be enough to totally stimulate users to comprehend the abstract or to think about a system in a new way. Because of that, systems designers must allow for modifications from the users. Some modifications may be impractical because they require changes to the system structure, but others are likely to be items that should have been considered in the original design. If there is an underlying systems architecture, it is important not only to permit these mid-process adjustments, but also to encourage them.

This style of systems development may be challenged by some, particularly on the basis of the personnel requirements and cost overruns which are a natural outcome of in-stream adjustments. But these complications are only a factor if they haven't been planned for. The major benefit of this development style (often labeled "laying track in front of the train") is that the process generates a high user involvement and a constant user sense of progress. There is always a sense of urgency, but urgency begets productivity. As the system begins to unfold, it is likely that users will begin to take ownership of new ideas or techniques. And if they do that, it is also likely that the new method will be implemented.

Credibility also involves being very forthcoming with people about the vision, even if the vision seems too abstract or futuristic. As different components of the vision come to pass, people will remember who first told them it would be possible. Every technology initiative that is undertaken, every project that is approved, should be publicized as being a connected part of the vision. It should all be shown to be part of the overall strategy that is continually discussed and worked on. That way, the user community keeps getting a sense of progress.

# IV
# Realization of the Vision: The User Information System

At Boston College, we have developed an integrated systems architecture which provides a platform on which to build all applications, and which enables campus-wide data sharing. These systems can be characterized as interactive, integrated, and highly standardized. The application of standards includes screen formats, program structures, naming conventions, data definitions, and access codes, resulting in a consistent user interface across all systems. Most importantly, the single system architecture, the single directory, the single access control system, and the data requirements are all complete. In a sense, the hard work is all done, and as new technologies become available from vendors, we will simply attach the appropriate services to the system as component parts.

The conformity to standards and a single architecture has provided some obvious technical benefits, but it has also furnished a base for providing a true end-user computing environment characterized by ease of access and intuitive interfaces. In the true user information system, all transactional data and information are entered directly into the system by the originator, not by some intermediary. For example, professors should be able to enter grades directly into the system, students should be able to register for courses online, advisors should be able to retrieve degree-audit information, chairpersons should be able to prepare course descriptions; the list goes on and on. The extent of the capabilities is limited only by the designer's imagination. Many of these activities may require automated approval procedures but they are all illustrations of the reduction of clerical tasks and the elimination of the manual transmission of paper among parties.

The guiding principle that we have used throughout the process of building the Boston College User Information System (UIS) is that all members of the community, including faculty, staff, students, prospective students, alumni, and outside agencies, must be provided open access to administrative information. Everything we do supports the premise that open access benefits both the institution and the campus community. In realizing the UIS vision at Boston College, we have implemented a number of policies and techniques which we think of as unique or innovative. A few of these have caused some controversy, but each one has contributed to maintaining our long-term vision. Some of the features which support or evolve from this platform are outlined in the following pages. Many of the descriptions are only snapshots of an ongoing process; the procedures and applications constantly evolve as both the technologies and the needs of users become more sophisticated.

## Single System Image

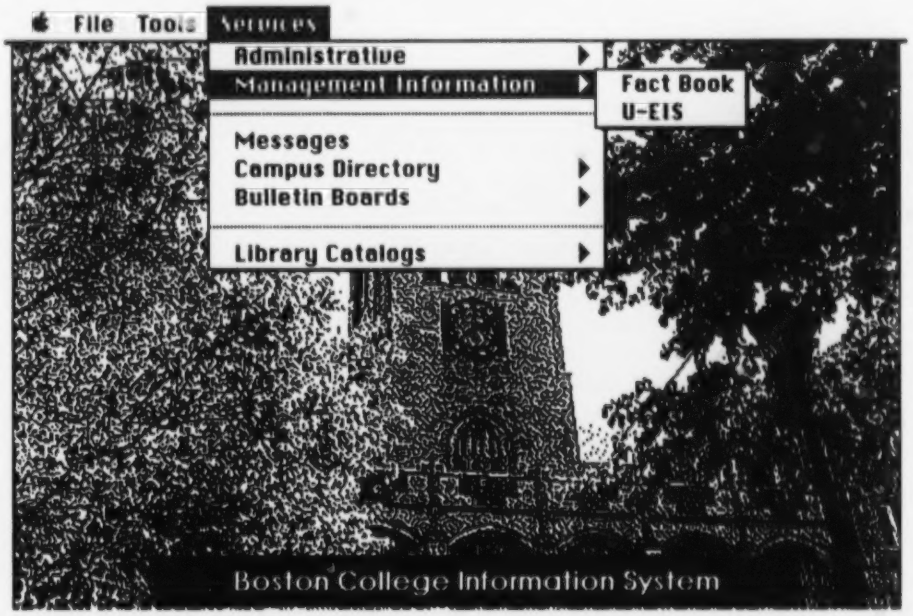
Central to our systems architecture is what Bob Heterick has called a "single system image," which he described as a natural extension of the user's native environment, free from specific computing and communications protocols.[8] As users become connected to large networks with a mix of vendors, software, and communications protocols, there is a need for a single log-on sequence, a single system access-control scheme, and transparency between applications. Users should be able to log onto the network and be authenticated just once, instead of logging onto separate computers and applications with separate procedures. The procedure should include authentication of individual nodes as well as users, and encryption of data. The key is the establishment of a name directory that will permit a single log-on capability for users, instead of logging onto nodes. Boston College's UIS is designed so that the user views a single system which can be customized to individual needs with the appropriate functionality.

## Functional and Customized Menus

The design and presentation of menus is determined by the functionality of the interactive device and how it is being employed. If a device is being used for a special purpose and

[8]Robert C. Heterick, *A Single System Image: An Information Systems Strategy*, CAUSE Professional Paper Series, #1 (Boulder, Colo.: CAUSE, 1988), p. 11.

*Example of a graphical interface that allows users to access information systems using familiar pull-down menus.*




**The idea for this interface was based on a design that originated from an application program called MacNotis (public domain software developed at Texas A&M University) which the author adapted to suit Boston College.**

limited function, such as an ATM, then the user interface must remain static and easy to use. For example, a public kiosk that utilizes a graphical interface should probably use touch-screen technology and on-screen buttons rather than a user interface with pull-down menus. On the other hand, a customizable screen with a graphical interface common to all applications is appropriate for desktop systems. After logging on to the system, individual users, who have access to a variety of applications, need to be presented with a menu of functions that can be easily customized by the user. The user establishes a dialogue with the system which states the desired functions immediately without needing to select an application system, signing on to that system, and stepping down through a menu structure. This function-based menu approach also provides the user with transparent access to data, thus eliminating the need to know where data are located. These menus are customized by associating an individual with an access classification (faculty, staff, or student) and providing an appropriate portfolio of functions.

The system should be able to control access to information and only deliver legitimate functions to users, but the ability of users to customize menus is essential. The information resources should be viewed as a smorgasbord, so that users can pick and choose the items that are of most interest, and arrange the presentation to meet their specific needs. Users should also be free to not choose available services as menu items.

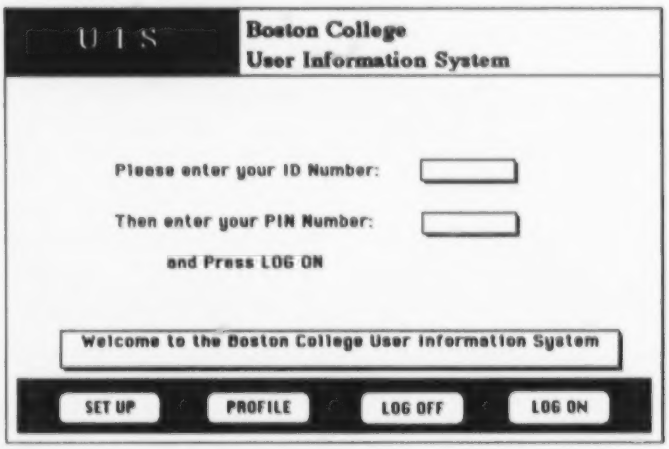
On many campuses, there are projects in progress to design and implement executive or decision support systems. The design process usually includes the traditional needs assessment of top executives who often have a difficult time expressing their requirements. The mistake that systems designers often make is to try to determine the information need based upon the expected decision. When the system is actually implemented, the executive's access needs immediately change. In these situations, the support system design is probably linked directly to the stated executive needs, but the varying needs of executives have made the system obsolete or restricted it severely. Trying to format a standard set of menu functions and information resources for all individuals or class of individuals is not the solution. For example, one executive may want access to a full range of information resources in a disaggregated form, while another executive at the same level may only want to see a limited set of standard reports on a regular schedule. The only reasonable solution is to permit access, under proper controls, to whatever is available, and to allow the individual to customize his or her own menu.

With a variety of software resident in workstation, server, and host environments, the establishment of software standards at all levels facilitates the ease of cooperative processing in a transparent mode. For example, the user may create a mail message by composing the memo on the workstation and only attaching to the network to send the memo. Pointing and clicking on a function creates another window with a set of menu functions. The function-based menus are designed primarily for the uninitiated users; they do not preclude access to application systems using traditional terminal applications. In fact, in order to attain maximum productivity, many high volume users will continue to operate in a locally-attached mode with a fixed-function workstation.

## Consistency

All institutions are not likely to attain complete integration of all systems, but it is still important to develop a perception of a single system. The use of a common access control identifier, such as user name, is one important component; another is to provide consistency in naming systems. For example, all systems at Boston College are referred to as the U-Series, where "U" stands for user, which implies that all the subsystems are integrated and user-focused. The voice response registration system is called U-Dial, the purchasing system is U-Buy, the ATM student information access system is U-View, the food service system is U-Dine, the electronic mail system U-Mail, and so on.

***The common log-on procedure allows access by ID number and personal identification number.***




The system design permits access to information from multiple device types. In cases where the telephone is used to interact with the system, the application is designed to function the same on all platforms, with the telephone keypad being the lowest common denominator. This design is referred to as the RISK, or Reduced Instruction Set Keyboard, technique. An example of this type of application is student course registration drop/add. In this application, the user is restricted to numeric entries (i.e., social security and personal identification numbers, course numbers, and selection and response keys) and function codes (i.e., star and pound signs). The terminal operator in the registrar's office with a full-function keyboard uses the same limited keyboard functions and numeric entries, and the same is true for a student processing the transaction using an ATM-type device, which utilizes a keypad similar to a telephone.

## Access Control

At Boston College, access to the UIS is controlled through a position control function, university ID cards, and passwords and personal identification numbers (PINs).

### Position-related access

As individuals are hired, terminated, or change positions, the university's human resources system automatically assigns to the individual position-specific attributes, such as office location, telephone number, job title, and so on. In addition, the system assigns the access control profile associated with the job. Individuals may hold multiple jobs, or may attend classes in addition to being employed. At the time that the individual becomes associated with or changes status with the university, his or her information is entered as a normal transaction function into the system (human resources or student record systems) which automatically alters the individual access control profiles that are associated with the individual. The person's personnel and/or registration records determine group or class assignments.

When they log on, users are allowed to gain privileges in one of five ways: by groups or classes to which they belong (i.e., faculty, staff, and students); by responsibilities associated with specific jobs; by individual (for access to his or her own records); by data dependency; or by organizational structure. At that time, the system applies the rules and develops a set of user profiles. The access control facility then maps all of the appropriate profiles together so that a composite of the individual's privileges is recalculated at the start of each session.

### ID cards

As soon as an individual is identified through the transactional system as being associated with the institution as an employee or student, the UIS automatically generates identification information. Usually the first action of a new student or employee is to obtain a university ID card, which contains a unique bar-code label and an encoded magnetic stripe. This card serves as a passport that has universal usage across campus.

The investment in an information system, by the way, should not be measured solely by the initial cost of the systems development effort, or by the usefulness of the system to service the primary user offices. The real payoffs come when the facilities in the system architecture are fully exploited or used by other applications within the UIS. For example, many universities issue a single identification card to every student, faculty member, and employee, while others issue

different ID cards for different application systems. The benefits of a single ID card in terms of lower production costs and increased utility across many applications are obvious.

**Passwords and PINs**

When a Boston College ID card is issued, the UIS also automatically generates a unique username, password, and PIN for each individual. This set of unique identifiers collectively form the common user identifiers that are utilized by all applications in the UIS. The UIS then generates a notification which includes the user's identifiers, voice and data privileges, and operating instructions so that the individual can begin accessing the system on the first day of eligibility.

The changing of passwords on a regular basis is one of the standard controls in most security systems. In an environment where users are constantly accessing a system, this procedure works well. But if there are many infrequent users, a different set of issues arises. Infrequent users will often write the password on a piece of paper, or will be discouraged from using the system because either they can't remember the password or it has expired. With large numbers of users, this can cause a logistical and administrative nightmare.

It is interesting to note that banks do not require users of ATMs to change passwords on a regular basis, even though unlawful access could result in the theft of cash. It is likely that the banks have concluded that it is better not to require frequent changes if by not requesting them, customers will be discouraged from writing passwords on their bank cards or on pieces of paper in their wallets. The same logic applies to dealing with limited access to information by the entire university community. This is accomplished by providing a unique PIN to all owners of a campus ID card at the time that the card is issued. Because the PIN is unique, it also serves as another student, faculty, or staff ID number. The PIN can be thought of as "half a password" that provides the first level of access control, determining the menu of services available to the users. Passwords and associated restrictions are required for deeper access privileges.

**Common User Identifiers Unique to Individual Users**

- ID Card
- Person's Name
- Facial Image
- ID Number
- Magnetic Stripe
- Bar Code Label
- User Name
- Personal Identification Number
- Passwords
- Position (Job) Number(s)
- Building/Room Number
- Telephone Number
- Network Node Name
- Vehicle Tag Number
- Others...

The concept of the PIN also differs from passwords in another significant way. Just as the student, faculty member, or staff member will use the same ID card to access many application systems, the individual will also always use the same PIN. The repetitive use of the PIN in many applications makes it easy to remember, and at the same time, serves better than other possible qualifiers, such as birthdate.

**Extended hours**

On most campuses, providing service to students in the library and public computing facilities, as well as normal access to computing networks, is nearly a seven-day-a-week/twenty-four-hour-a-day proposition. Students should be able to use the services of the network not only for course work, but also to access administrative systems, similar to the way we now conduct our banking business. Since the lifestyles of students are not synchronized with standard Monday-through-Friday, nine-to-five office hours, at Boston College they have the ability to conduct business with the administrative offices of the university beyond normal working hours. For example, students can retrieve grades, review their student account, register for courses, and print course schedules by gaining access to the central directory and access control system in the UIS.

## Central Directory

Identification information, security profiles, and demographic data for all individuals associated with Boston College are stored in a central directory which forms the basis for directory services functions. The campus telephone directory is extracted directly from the system just prior to publication. This directory is also available online in all computing environments as one of the standard menu functions. Usernames are unique so that each user has a primary mail address, but if the user has mail addresses on multiple machines or servers, the user name is the same in all environments and is known to this central directory.

The central directory can be viewed as a collection of business cards for everyone affiliated with the university, including students. Like the business card, each directory entry contains name, title, campus address, telephone number, electronic addresses (user name and node), and FAX number. By employing a central directory service, it is not only possible to interconnect electronic mail systems into a single system, it is also feasible

to consider using a single identification to access all messages, whether they are voice, text, or facsimile.

The system recognizes individuals not only by username, PIN, and password, but also by other common user identifiers, such as name, social security number, and ID-card bar code and magnetic stripe. In addition, the system can retrieve an individual identity through departmental directories, or by pointing either to a graphical representation of a building floor plan or to an organization chart.

The hierarchy of departments and positions is defined within the system, and individuals, by virtue of occupancy in a position, may have access to information that is available to individuals in positions lower in the structure. For example, access to budget information for a grant in the biology department should be provided to the principal investigator by virtue of his or her job responsibility. The dean of the college, who may be seven or eight levels up in the hierarchy, may not be directly responsible for the budget, but would have authority to access the budget information using a workstation or telephone voice response system.

Individuals have access to their own and only their own personal records. For example, a student has access to his or her student account, financial aid, grades, and other records; employees have access to their own personnel, payroll, and student records. Individuals also have access to records based upon the data resident in records in the production systems. For example, a faculty member has access to records of individual students for advisement based upon the registrar's designation of the faculty member as the advisor in the student's record.

## Intelligence

The UIS is designed to easily employ intelligent routers. These routers are composed of a set of tables maintained by custodial user departments and allow a user to execute mail or forms-routing transactions without stipulating the receiving party or parties. The designation of recipients is determined at execution time by associating tables of positions with individuals and making an assignment. Built into the application system architecture are functions, or "software watchdogs," that reside on the system external to the actual applications. These watchdogs consist of rule-based software which inspect data looking for conditions that are identified by the rules. Journal files or audit trails are employed principally as mechanisms for recovery in the case of a system problem or to trace a problem, and these data management facilities are a convenient resource as input to a software watchdog. The isolation of access control from the actual application permits the system manager to distribute applications without requiring modification to application code. In addition, the application code is simplified, ensuring ease of programming and maintenance.

## Messaging

The Boston College system uses a mechanism to provide the user with transaction-generated messaging by having intelligent agents which know "who should know what," and automatically triggering messages or reports based on activity. This feature alerts individuals on a timely basis, rather than requiring the user to execute queries. For example, this facility automatically generates an electronic mail message to a professor alerting him or her to a student's withdrawal from the professor's course. In traditional database environments, we have written systems that communicated on an application-to-application basis, i.e., one program sending data to another program. In electronic mail systems, the communication is usually peer-to-peer, i.e., an individual sending a message to another individual or group of individuals. In the integrated database/mail environment, applications talk to peers and peers to applications.

Individuals are also able to initiate mail by addressing the message to a group and utilizing automatic distribution capabilities. For example, a professor can address a class assignment to all students enrolled in a course, as long as the system has determined that the professor issuing the memo is also the instructor. If authority is granted, the system uses the class list to determine the students and the corresponding directory entries to determine the appropriate routing schemes.

The system accepts messages and forms from different computing sources, and a single routing scheme is utilized for distribution of all messages and forms. Users who do not have an electronic address or who do not read messages within a prescribed time limit receive a printed copy automatically through campus mail. All of the computer-generated campus mail is pre-sorted in accordance with the manual filing scheme in the campus post office.

## Status Tracking

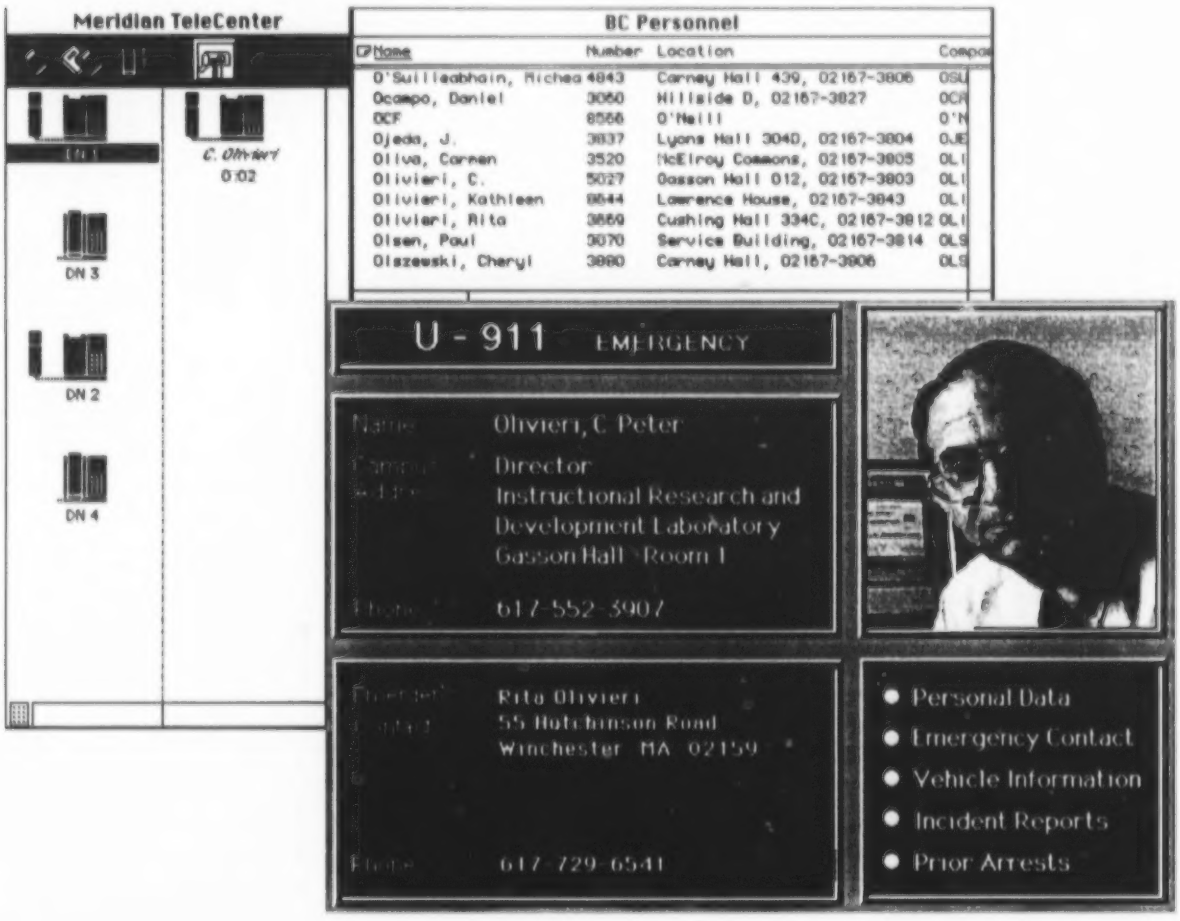
One of the most frustrating and time-consuming tasks for most administrators is tracking the status of something. That "something" might be anything from a payment to a vendor, to a repair order to fix a light bulb, to a change request to a computer programmer. In our daily work routines, we initiate forms, sign approvals, and engage in a host of actions that we assume will advance to the next proper stage, to be acted upon in a timely and responsive manner. Of course that is not always the case, and in many instances, there is no means of identifying the delay.

Many documents continue to circulate in a non-automated format, moving from one department to the next on paper, and flowing through the campus mail room. The ability to track this correspondence is nearly impossible. The same is true if one wants to trace mail and packages delivered via the

United States Post Office. Federal Express built a major corporation upon this weakness of the U.S. postal system. In the Federal Express system, all items are tracked at all stages of delivery, allowing the sender, the recipient, or the Federal Express employee to determine the whereabouts of any document at any time

In the Federal Express system, tracking is accomplished by routing all items through a central site in Memphis, Tennessee, for overnight delivery. In the campus model, all transaction information is routed through a central status server. The status server is composed of a set of rules, messages, and routing tables. Each electronic transaction is interrogated against the rules, and if the transaction meets a condition of one of the rules, a status message is generated to include it in the stack of status messages as determined by the routing tables. In the manual transmission of information, such as U.S. Mail, there is always a question about how quickly a message will be delivered and then read. In an electronic system, this status information is known by date and time, and it is not only extremely useful for tracking purposes, but can also function as a receipting mechanism.

***Example of an integrated voice and data application, where the telephone call automatically accesses the caller's records in a database.***



## Voice/Data Integration

Despite the growth of networks and proliferation of desktop devices, the telephone remains the ubiquitous communication device in the home and office. The convenience of the telephone permits documents to be transmitted using a FAX machine, and the telephone has gained acceptance at colleges as a means for students to register for courses from their homes. In many instances, voice and data are being serviced over the same medium—twisted-pair wiring—and telephone switches and computers are gaining a higher degree of integration.

At Boston College, the UIS is currently being adapted to support integrated voice and data services through a common set of controls that will manage access to both network and information resources. Included in the plans are the integration of electronic and paper campus mail facilities with the voice mail system, so that users can be alerted to entries in their voice mail boxes from the electronic system, and vice-versa. When a user provides a personal identification number to the telephone system for long distance access, it will be the same PIN that is used when logging on to the data system, and telephone access security and privileges will be managed by the same security routines and techniques. The UIS will also support the integration of databases and telephone services. For example, at help desks the database record of a caller will automatically be displayed on the screen.

Users will also be able to access administrative systems information through the use of a touch-tone phone. For example, a department manager will be able to check on the status of a budget by entering an authorized account number, and prospective students will be able to check on the status of their applications. The system may support both stored and synthesized voice applications, and the selection of the appropriate technique by the system integrator will be based upon the audience. All systems will be designed with date and time stamp functions so that users can perform status checks using either voice response or workstation access.

This list of guidelines and features is not meant to be all-inclusive, nor will every one of them apply to every campus. But by developing this focused approach for Boston College, we have been able to implement some interesting and unique applications, a few of which, most notably U-View and the innovative use of ATM technology, have attracted a great deal of attention. All of these features have been developed and implemented as the various technologies became available, and have been helped along by the adherence to the techniques presented above. Each application represents another step within the overall concepts of the User Information System and provision of open access to campus information.

# V
# Conclusion

Entering a new decade provides an excuse to reflect on the events of the past and to prognosticate. It is simple to look back and see how the major changes affected our operation and how we reacted. It is not so easy to remember how well (or less well) we were prepared, or what we were thinking or conceptualizing a decade ago. To satisfy my own curiosity, I reread an article that I had written for the November 1980 issue of *CAUSE/EFFECT* magazine entitled "Solving Puzzles in Little Pieces," and was rewarded to find that most of the concepts and principles in that article are still applicable.

A current trend in higher education computing suggests that everything that has been done up to now needs to be totally restructured. In order to solve all our problems, we simply have to abandon the huge investment that has already been made, distribute all computing, and radically change the way we do business. But for many institutions, this solution is not only simplistic, it does not get at the heart of the real issue. The question is not which parts of information technology get distributed and which do not but, rather, how we can provide what users are really after: open and easy access to information.

Each campus will go about this differently. Boston College seems to have found some ways that work, but we are, like most places, still searching for the right combination of strategies and techniques. The thing that does make our campus notable, however, is the consistency with which we have adhered to our long-term vision. We have spent a great deal of time and effort in laying the groundwork, and now, as new technologies and applications come along, we are in a position to be able to take advantage of them.

The need for information systems managers to provide leadership in this area is critical. The information systems manager needs to provide an absolutely solid foundation, needs to be persistent in the face of all sorts of temptations and pressures in contrary directions and, most of all, needs to be engaged in a long-term and consistent "selling" effort to the rest of the campus community. Dealing with the management issues is every bit as important as the system design itself, and requires us to keep promoting the vision at every opportunity.

We can also learn from other types of organizations. Looking beyond higher education to the innovative use of information technology in the world outside can be a useful and stimulating thing to do, leading us to think how different features and ideas can be adapted to a campus setting.

As information systems managers, we are often overwhelmed by the almost daily changes in technology and the emergence of new products and services that may or may not affect our institutional environments. Is it possible to be omniscient? Of course not. But even if we are aware of changes, the challenge is how to apply these new capabilities or technologies in an operating environment, such as college administrative systems, where change is slow, and drastic change is not usually wanted. The information system architect must be able to use acquired knowledge to foresee future trends in technology, to determine how these changes might affect the campus information infrastructure, and to judge how the concepts and principles of the system architecture will accommodate the innovations.

It is the vision that is central to the whole process. Open access to information is Boston College's vision because it is cost-effective, because it reduces layers of bureaucracy, and most important, because it provides a true User Information System. Now that the foundation has been laid, information technology is helping us achieve the vision.

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# Apple Computer, Inc.

## Company Profile

Apple Computer, Inc. develops, manufactures, and markets personal computer systems—education and business tools that extend our capabilities to learn, work, communicate, and play.

## Involvement in Higher Education

Since the introduction of the Macintosh personal computer in 1984, Apple has enjoyed growing success in the higher education market. Much of the Macintosh computer's popularity on campus is due to its intuitive graphic interface, its ease of use and learning, and the large base of innovative software available. Apple has also invested heavily in bringing new hardware technologies, networking and communications solutions, software development, and strong program support to higher education. Today, Apple offers a comprehensive suite of programs in administration, instruction, and research that provide an infrastructure of support for any campus computing plan.

The Macintosh personal computer system assists technology professionals on campus to effectively manage complex campus computing environments by providing them with the capability to access information quickly, easily, and transparently through any type of campus network, and by serving as a front-end into large-scale mainframe relational databases. The Macintosh also has an intuitive graphic interface that maintains a high level of software consistency and integration across all applications, resulting in low requirements for support and training. At the University of Texas at Austin, a Macintosh front-end is being used to access the IBM mainframe. This front-end was developed on HyperCard with NATURAL Connection from Software AG. Several components of this "University Workstation" project have been completed—the Library System (UTCAT), Fiscal Information System, and University Directory. The University's goal is simple, secure, campus-wide access to university information.

Apple's academic programs offer curriculum and research solutions in specific disciplines, courseware development and distribution, training, and service. Innovative support programs that focus on lowering the cost of campus computing include special pricing, student and institutional financing, and site licensing. An exchange of information about technology and education is facilitated through conferences, seminars, publications, and AppleLink, an online database, electronic mail, and bulletin-board system that links scholars and educators directly to Apple, their colleagues, developers, and dealers. In addition, the AppleLink/BITNET/Internet mail relay facilitates communication between colleagues on BITNET, the Internet, and AppleLink.

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Apple continues to introduce new products that offer innovative solutions for both academia and administration. The compact Macintosh product line includes the Macintosh Classic and Macintosh SE30 computers offering good performance at affordable prices and flexibility for those who need an easy-to-use, powerful navigation tool for accessing, managing, and communicating information. The modular Macintosh product line includes the Macintosh LC, Macintosh IIsi, Macintosh IIci, and Macintosh IIfx computers. These modular systems provide the power needed for transparent access to an array of databases, advanced programming, software development, simulations, and high-speed communications. The Macintosh Portable computer provides the advantages and power of Macintosh everywhere you go. The Macintosh family of personal computers can be easily and inexpensively interconnected with Apple's network cabling. This is called the AppleTalk Network System, and it supports a mix of cabling standards such as twisted pair, fiber, Ethernet, and Token Ring. They can also be seamlessly integrated with DEC, IBM, UNIX, and

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The advent of Apple's CDSC CD-ROM, video laserdisc, HyperCard, new hypertext reference tools, and optical media allows individuals to access, use, and create information from a variety of sources—print, images, video, sound—and customize the information to meet their individual needs.

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As the computing needs of higher education become even more complex, Apple continues to work closely in partnership with administrators, faculty, and students to make technology useful and meaningful in education.

*Upon joining CAUSE in 1985, Apple Computer, Inc. donated four Macintosh 512K microcomputers, two ImageWriter IIs, a LaserWriter, and related software to the CAUSE National Office. Since that time, Apple has upgraded the LaserWriter to a Plus and donated two Macintosh IIs, four Macintosh SEs, two Macintosh Plus computers, an 80 MB and a 20MB hard disk, and AppleShare to facilitate intra-office communication. At past CAUSE national conferences, Apple has hosted exhibits, sponsored refreshment breaks, provided computers and printers to allow on-site printing of nametag sheets and the publication of a daily conference newsletter, and set up HyperCard-based conference messaging systems. Publication of* Open Access: A User Information System, *CAUSE Professional Paper Series #6, was funded by Apple.*

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*The office of Peter Wilson, assistant professor at Stanford, is a prime example of Macintosh-to-DOS connectivity. Wilson uses both Macintosh and IBM personal computers extensively, and stores vast amounts of data for both computers on a single CD-ROM drive.*

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